end of the lake. On the western side of these and near the horizon cirro-stratus and alto-stratus clouds prevailed. These phenomena probably would not have been observed had not the men been admiring a beautiful sundog visible at the time.

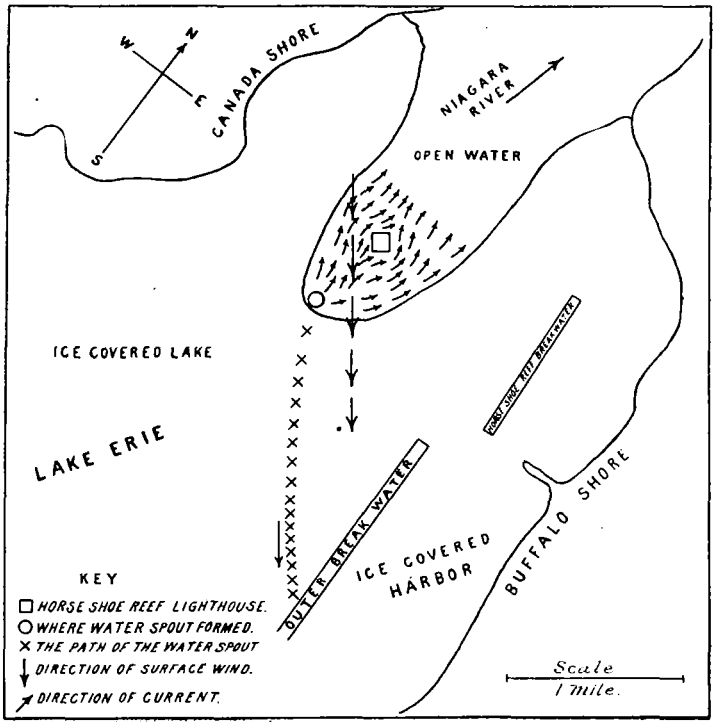

FIG. 1.—Location of waterspout off Buffalo, N. Y., February 11, 1907.

INTERNATIONAL METEOROLOGY.

REPORT ON THE PROCEEDINGS OF THE INNSBRUCK CONFERENCE.

The elaborate report on the proceedings of the International Meteorological Conference of Directors, held at Innsbruck in September, 1905, has been published by the Centralanstalt at Vienna, as an appendix to its annual for 1905. The report consists of three parts—the provisional program, the daily proceedings, and the reports of subcommittees—and an appendix of 90 pages containing articles contributed by over thirty meteorologists. The entire volume is one of the most important of the international meteorological publications. On page 44 the subcommittee on the international meteorological codex reported that this important work was practically finished, and exprest the hope that it would be published in English, German, and French.

The same committee also reported that the international comparison of normal barometers, namely one or two for each national service, is still in the most unsatisfactory condition, and should be undertaken at once; and in accordance with information received by the committee it recommended that the central offices at Berlin, London, Paris, St. Petersburg, and Vienna should prosecute the work. Since the meeting of this committee at Innsbruck Professor Sundell has published the results of his elaborate and successful personal work on this subject since 1885, and has shown that the international comparisons are now practicable at less expense and with greater accuracy than at any time previously. The extensive work done by Dr. Frank Waldo, who at that time compared Washington, Cambridge, Toronto, Kew, Hamburg, St. Petersburg, Berlin, and Paris, can now be repeated with greater advantage. This is, in fact, a work that can no longer be delayed if we would secure for barometry the international accuracy demanded by the progress of meteorology.

The subcommittee on clouds presented a series of revised definitions of cloud names, (*stratus, lenticularis*, etc.), and recommended the publication of additional charts in the new edition of the international cloud atlas.

The conference resolved that hereafter the international committee should consist only of the directors of services. Accordingly its present membership is as follows: Chaves, Davis, Eliot, Hellmann, Hepites, Hildebrandsson, Lancaster, Mascart, Mohn, Moore, Nakamura, Palazzo, Paulsen, Pernter, Russel, Rykatchew, and Shaw. At the first session of the new committee, held on September 14, Mascart was chosen president, and Hildebrandsson secretary.

INTERNATIONAL METEOROLOGICAL CODEX.

This publication, referred to above as having been presented to the Innsbruck meeting, has been published in German by the Meteorological Office at Berlin. It contains viii + 81 pages, and a chart showing the international form for monthly and annual results for stations of the second order. Its contents may be divided into: (1) historical, followed by (2) the resolutions that are now in force or important relative to the general conduct of meteorological observations, computations, and publications; these are a codification of the results of all the international conferences, from that at Leipzic, 1872, to that at Innsbruck, 1905, and the English edition will be as desirable as the German; (3) the twenty pages of index constitute virtually an index to the contents of all the appendices of all the successive international reports. We undoubtedly owe this to Dr. G. Hellmann, whose high appreciation of the importance of bibliography is shown by the resolution offered by him at the conference at Rome, urging the need of a catalog of published observations and a catalog of published memoirs bearing on meteorology. In response to this international wish the German bibliography by Hellmann has already been published, but the general bibliography undertaken by the Weather Bureau is still unpublished. The international meteorological tables were published in Paris in 1890.

This codex will save a great deal of labor and uncertainty in hunting thru the seventeen or eighteen volumes of international reports, and it is to be hoped that the English, French, and Spanish editions will be able to reproduce exactly some of the more difficult passages in the authoritative German, especially the definitions of phenomena, such as halos, *rauhfrost*, and *glatteis*, about which there seems to have been much confusion in the past.—*C. A.*

RAINFALL AND OUTFLOW ABOVE BOHIO, IN THE VALLEY OF THE CHAGRES.

By Gen. HENRY L. ABBOT, U. S. A., retired. Dated Washington, D. C., April 9, 1907.

The exceptional uniformity both as to temperature and rainfall existing in this tropical valley, and the entire absence of frost and snow, render a study of the ratio between downfall and drainage much more simple than in the Temperate Zone. The subject has an important bearing upon certain engineering problems of the Canal, and received early attention from the New Panama Canal Company. The preliminary results appeared in the MONTHLY WEATHER REVIEW for June, 1900,[1] and in the number for February, 1904,[1] a full summary of six years' observations was given. The records have been continued since the work past under the control of the United States—that is to say, to the beginning of the current year, thus adding three more years to the accumulated data. The important bearing of the subject upon many economical questions now receiving attention in this country, such as irrigation, the water supply of cities, generation of power, etc., may render a brief summary of the results of these nine years' investigations interesting to hydraulic engineers. The methods employed were identical thruout, and were so fully explained in the paper in the MONTHLY WEATHER REVIEW for February, 1904, that a tabular statement will suffice to bring the matter up to date (see Table 1).

[1] Vol. XXVIII, p. 243, and Vol. XXXII, p. 57.

It will be noticed that the 6-year, 3-year, and 9-year series accord perfectly in indicating a progressive change in the ratio due to variation in ground-water flow from month to month, and that the multiplication of data has the usual effect of smoothing irregularities in the curve. All three agree in showing the high annual ratio of 65 per cent. It need hardly be stated that the values are found not by averaging the ratios but by computation from the means of the sums of the quantities involved (rainfall and outflow), due weight being given to the number of days per month. Additional interest is given by the fact that the region is densely forested, and thus in a natural condition.

TABLE 1.—*Rainfall and outflow in the Valley of the Chagres above Bohio, 700 square miles.*

Months.	Mean depth of rainfall in millimeters.			Mean outflow in cubic meters per second.			Ratio.*		
	6 years.	3 years.	9 years.	6 years.	3 years.	9 years.	6 years.	3 years.	9 years.
January	147	106	133	122.5	76.8	100.6	1.18	1.07	1.12
February	27	20	25	40.5	39.6	40.2	2.00	2.64	2.15
March	34	27	32	25.7	26.4	25.9	1.11	1.44	1.20
April	75	155	103	33.5	49.7	38.9	0.64	0.46	0.54
May	266	319	284	57.6	73.6	62.9	0.32	0.34	0.33
June	270	286	275	84.3	90.9	86.5	0.44	0.45	0.45
July	394	319	369	124.5	113.6	120.9	0.46	0.53	0.48
August	361	341	354	139.0	120.1	132.7	0.58	0.52	0.55
September	291	285	289	140.3	142.4	134.3	0.65	0.71	0.66
October	361	277	333	164.3	145.6	158.1	0.68	0.78	0.70
November	432	412	425	226.5	193.5	215.5	0.75	0.67	0.72
December	176	220	191	133.5	182.0	149.7	1.14	1.22	1.16
Year	2834	2767	2812	106.8	104.5	106.0	0.65	0.65	0.65
3 dry months	136	202	158	33.2	38.6	35.0	1.05	0.82	0.95
9 rainy mos	2698	2565	2654	131.4	126.5	129.8	0.63	0.63	0.63

*See Monthly Weather Review, February, 1904, Vol. XXXII, pp. 60–63.

TABLE 2.—*Disposition of rainfall above Bohio (based on records for nine years, 1898–1906).*

Months.	Mean rainfall in inches.	Mean outflow in feet-seconds.			Mean outflow in inch-miles.			Evaporation in inch-miles.
		Total.	Direct flow.	Ground water.	Total.	Direct flow.	Ground water.	
January	5.24	3552	951	2603	5.86	1.57	4.29	Negative.
February	0.99	1420	20	1400	2.11	0.03	2.08	Negative.
March	1.26	915	23	892	1.51	0.03	1.48	Negative.
April	4.06	1374	763	611	2.19	1.22	0.97	1.87
May	11.19	2222	2020	202	3.65	3.32	0.33	7.54
June	10.84	3055	2037	1018	4.87	3.25	1.62	5.97
July	14.54	4269	2668	1601	7.03	4.39	2.64	7.51
August	13.95	4687	2556	2131	7.73	4.21	3.52	6.22
September	11.39	4743	2157	2586	7.57	3.44	4.13	3.82
October	13.12	5585	2393	3192	9.20	3.94	5.26	3.92
November	16.74	7613	3172	4441	12.13	5.05	7.08	4.61
December	7.52	5288	1368	3920	8.70	2.25	6.45	Negative.
Year	110.84	3727	1677	2050	72.55	32.70	39.85	38.29
3 dry mos	6.31	1236	269	967	5.81	1.28	4.53	0.50
9 rainy mos	104.53	4557	2147	2410	66.74	31.42	35.32	37.79

These statistics throw an interesting light upon the ultimate disposal of rainfall in this basin. It was shown in the former paper, based on six years' records, that the ratio in five subdivisions for the minimum month, that of May, was 0.30 ± 0.03. This figure is confirmed by the three additional years now available, for which it was 0.34. Since May is at the end of the long, dry season, it is fair to assume that in it the flow of ground water has practically ceased. If so, the ground flow during each month of the year may be computed from the above data, since it is equal to the measured monthly flow less the product of this quantity by the quotient of 0.30 divided by the observed monthly value of the ratio. The accompanying Table 2 exhibits the result of such a computation in the seventh and eighth columns. The figures are given in English units, and in a form directly comparable with the rainfall. This comparison between direct and ground-water flow will be found interesting; the latter curve passes thru a minimum in May and a maximum in November, and its progressive character conforms to what might be expected from gradual seepage thru the earth under the rainfall conditions; the curve of direct flow has also a natural form, and indicates that without the ground flow the river would run nearly or quite dry in February and March, as do now most of its smaller tributaries.

Classing as evaporation the difference between rainfall and total river flow, the values may be expected to vary considerably from month to month; but the mean for the year, representing a complete cycle, should show a value approximately correct. This value is shown to be 38.29 inches, or about one-tenth of an inch per twenty-four hours. Direct measurements by the pan method have very recently been inaugurated on the Isthmus. They show for December, 1906, 0.135 inch per twenty-four hours; for January, 1907, 0.167 inch, and for February, 0.181 inch.

PANAMA RAINFALL.

By E. B. GARRIOTT, Professor of Meteorology.

Like other tropical regions that are swept by winds from the ocean, the Panama Canal Zone, in latitude about 9° north, has fairly well-defined wet and dry seasons. The wet season extends from April or May to November or December, and is called the *invierno;* the dry season extends from December to April, and is called the *verano.* In August there is in Central America an interval of comparatively dry weather that is called the *veranillo,* or *little verano,* or the *verano de Augusto.*

The rains of the wet season come in the form of local thunderstorms that are often torrential in character. In April and May they are usually confined to the late hours of the afternoon; they increase in duration and intensity until in June they often continue during the afternoon and night; they then decrease until August, after which they increase until the approach of the second maximum period of October or November, and then decrease until December.

The immediate cause of the rains of the wet season is found in the shifting of the equatorial rain belt that attends the sun in its annual march north of the equator, and the periods of maximum rainfall occur about the time the sun is in the zenith of Panama, the spring maximum attending the northward movement of the rain belt, and the autumn maximum its return southward movement. During the August interval of comparatively settled weather, which is more marked on the coast than in the interior, the equatorial rain belt is north of Panama.

The annual rainfall is much heavier on the Atlantic than on the Pacific side of the Canal Zone, the amount being about 157 inches at Colon (Aspinwall), and about 67 inches at Panama. At Gamboa, on the watershed at an elevation of about 102 feet, the annual rainfall is a little less than 100 inches. Rains that occur during the dry season are infrequent and comparatively light, and are produced by what are termed "northers" that in the winter months are sometimes felt as far south as Panama, and are also due to the trade winds that at times strike the Isthmus after crossing the warm Caribbean Sea.

On the Caribbean side of the Isthmus the dry season is confined practically to the months of January, February, and March, and the heaviest rains of the year are likely to occur in April. On the watershed of the Canal Zone the first four months of the year are usually dry, the spring maximum occurs in May, and the rainfall of the August *veranillo* is frequently heavy. The August interval of dry weather of the Central American countries as a whole is in fact inconspicuous along the Canal Zone. On the Pacific side of the Isthmus the wet season extends from May to November, inclusive, with periods of maximum rainfall in June and November, and the dry season of December to April, inclusive, is better defined than on the watershed and on the Atlantic side.